Office of Operating Experience Analysis, EH-33 • U.S. Department of Energy • Washington, D.C. 20585

OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

August 14 - August 20, 1998

Summary 98-33

Operating Experience Weekly Summary 98-33

August 14 through August 20, 1998

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EVENTS

1. SELF-CONTAINED BREATHING APPARATUS BREATHING TUBE FAILURES

On June 12, 1998, the National Institute for Occupational Safety and Health (NIOSH) issued a Respirator User Notice informing users of belt-mounted regulator model self-contained breathing apparatus manufactured by Mine Safety Appliances (MSA) that certain corrugated rubber breathing tubes may tear or separate unexpectedly. The tube connects the belt-mounted regulator to the facepiece and can be identified by the part numbers 801165, 803506, or 470734 stamped in yellow ink on one of the clamps at either end of the breathing tube.

NIOSH recommends that users immediately inspect and test these tubes to ensure that they are safe for their intended use. Users should stretch the tube 5 to 6 feet, hold it for 10 seconds, then release it. Users should then inspect the tube for signs of cracks, cuts, rips, perforations, tears, or any other signs of wear and verify that the coupling/tube connections remain tight. Any tube that fails these inspections must be removed from service.

MSA is working to determine the cause and extent of these breathing tube failures. Preliminary indications are that some breathing tubes may have recently been placed in service that are susceptible to premature failure. Failure could result in a complete loss of respiratory protection. Additional information on this subject may be obtained by contacting NIOSH at (800) 35-NIOSH or MSA at (800) MSA-2222.

KEYWORDS: industrial hygiene, self-contained breathing apparatus

FUNCTIONAL AREAS: Industrial Safety

2. UNPLANNED EMERGENCY COMMUNICATION SYSTEM OUTAGE

On August 9, 1998, at the Idaho National Engineering and Environmental Laboratory, the facility manager reported that the plant emergency communications system became inoperable when workers switched it to temporary battery back-up power and the batteries failed. Plant personnel determined that the entire emergency communication system was inoperable. The work plan to switch to new feed cables installed under an electrical and utility system upgrade project required electricians to interrupt the main power supply and supply the facility with alternate power from a commercial tie-in or from a generator. Investigators determined that electricians were unable to use back-up power to run the emergency communication system while performing maintenance, so they used the battery back-ups instead. When the batteries discharged, the system became inoperable. The loss of the emergency communication system resulted in the loss of alarms and voice paging capability and reduced the safety margin for personnel in the facility in the event of an emergency. (ORPS Report ID--LITC-LANDLORD-1998-0025)

Investigators determined that electricians successfully tied in commercial power to establish back-up power. Back-up power supplies limited ventilation, lighting, and emergency systems. When they transferred the emergency communication system to the back-up (commercial) power supply, the breaker serving back-up power circuits tripped. Investigators believe the breaker tripped because the back-up power loads exceeded the capacity of the breaker. Electricians decided to reset the breaker and run the emergency communication system on battery back-up for the duration of the outage. Investigators determined that the system was placed on battery back-up at 11:00 a.m. on Saturday, August 8, and became inoperable at 10:00 p.m. on Sunday, August 9. Investigators determined that Life Safety personnel approved the facility outage request, but they did not express any concerns about the emergency

communication system back-up batteries, which they knew were approximately 5 years old and scheduled for replacement. The facility manager instituted fire watches in response to the emergency communication system outage. Electricians connected the new feed cables and replaced the back-up batteries on the afternoon of August 10, returning the system to full operability. Facility managers are considering implementing corrective actions that include testing alternate power supplies in advance of power outages and changing power outage procedures to ensure improved communications with Life Safety personnel and other involved organizations during the planning and execution of the outage.

NFS has reported on occurrences involving inadequate work planning and procedure development in several Weekly Summaries. Following are some examples.

- Weekly Summary 98-12 reported that project engineers at the Fernald Environmental Management Project discovered that a demolition subcontractor general superintendent violated a safe work plan when he did not make all of the required critical cuts during the demolition of ducts and supporting structures for a boiler plant demolition project. The superintendent told investigators that he based his decision to deviate from the safe work plan on his belief that the plan was based on riveted structural steel members, whereas the as-found conditions were bolted connections. (ORPS Report OH-FN-FDF-FEMP-1998-0012)

- Weekly Summary 98-10 reported that an operator at the Oak Ridge Environmental Restoration Facility was removing a blank flange from an isolated low-level liquid waste transfer line contaminated liquid sprayed from the flange. The liquid was pressurized by the elevation head of the connected piping upstream. If work planners and supervisors had checked the piping arrangement, they would have recognized that the low point could be affected by a piping elevation of 5 to 10 feet and been alerted to the potential for pressurization. (ORPS Report ORO--LMES-X10ENVRES-1998-0002)

This event underscores the importance of developing a work plan that ensures that the work can be completed as intended. DOE facility managers should ensure that workers understand the importance of following work plans and safety rules. If conditions found are not as expected, work should be stopped immediately and, if necessary, changes should be made to the work plan. Discrepancies between expected conditions and as-found conditions can result in confusion and increase the potential for errors in work plan execution. This event also underscores the importance of good work planning and communications between involved organizations. Facility managers and work planners should consult the following references when scheduling maintenance.

- DOE-STD-1029-92, *Writers Guide for Technical Procedures*, provides guidance to assist procedure writers across the DOE complex in producing accurate, complete, and usable technical procedures that promote safe and efficient operations. This guidance can also be applied to other technical documents such as work plans. Section 2.3, “Facility Configuration,” requires walk-downs, simulations, modeling, or desk-top reviews to ensure procedures are technically accurate and adequate.

- DOE-STD-1050-93, *Guide to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities*, provides information on work controls and work coordination.

- DOE-STD-1031-92, *Guide to Good Practices for Communications*, discusses the need for clear, formal, and disciplined communications and provides guides to improve communications.

KEYWORDS: back-up power supply, battery, communication, electrical maintenance, procedures, work planning

FUNCTIONAL AREAS: Electrical Maintenance, Procedures, Work Planning

3. LOSS OF CONTROL OF SEALED RADIOACTIVE SOURCES

On July 29, 1998, at the Mound Plant, a radioactive source custodian reported a loss of accountability of 77 radioactive sources to the facility manager. Facility personnel initially determined that 160 sources were missing after conducting an inventory in April and May 1998. The facility manager ordered a search for the missing sources in June and July, and facility personnel found 83 sources. The lack of accountability of sealed sources can result in lost or improperly discarded sources and can lead to the spread of contamination and personnel exposure. (ORPS Report OH--MB-BWO-BWO04-1998-0007)

Subsequent to the notification report for this occurrence, facility personnel have either located or verified proper disposal of four more sources. The remaining 73 sources are still unaccounted for. Investigators determined that 45 missing sources are response check sources that previously were exempt under DOE regulations. The remaining 28 sources are calibration sources. Seven of these are exempt quantities; nine have various nanocurie levels of activity; four have various microcurie levels of activity; and eight have unknown activity levels. Investigators believe that these eight sources have low activity levels.

Investigators believe that there is a high likelihood that many of the missing sources entered the radioactive waste stream. Previously, when sources were discovered or were unwanted, personnel dispositioned them as part of the orphan source program, and their proper disposal was never annotated in the source database. Investigators have determined that, because of the sealed nature of the sources, the internal and external dose hazard is negligible for all missing sources.

NFS reported radioactive source accountability problems in several Weekly Summaries. Following are some examples.

- Weekly Summary 95-47 reported that a facility review of the Central Services Works Engineering Section at Savannah River Site disclosed an unlocked radioactive source cabinet. Investigators conducted an inventory and discovered that three Cs-137 sources were missing. Investigators located one source in the storage cabinet. The second source was on loan and properly recorded in the source location log. They located the third source in another area, but there was no record for transferring the source. (ORPS Report SR--WSRC--CSWE-1995-0012)

- Weekly Summary 93-20 reported that Health Physics personnel at the Savannah River Site discovered an ion chamber with a sealed 85-µCi source in a dumpster at the Vitrification Facility. They were conducting a search for previously exempted sources that were no longer exempt and required accountability. When Health Physics personnel searched other areas of the facility, they found three more sources. (ORPS Report SR--WSRC-WVIT-1993-0036)

These events emphasize the importance of strict accountability of radioactive sources and demonstrate the need for a strong radioactive source control program. All radioactive materials have specific handling requirements. Sealed source accountability programs should include consideration of changing administrative threshold limits and should notify all potential source holders of such changes. DOE maintains a regulatory position paper on sealed radioactive

source controls that delineates proposed requirements similar to those of the NRC. The position paper states that “these requirements were determined to be necessary for an adequate radiation protection program.” Personnel responsible for radioactive source control at DOE facilities should ensure their source control program includes the following elements from DOE N 441.1 through DOE N 441.3.

- administrative procedures for the control of accountable sealed radioactive sources
- labels on all accountable sources (or their storage containers or devices) with the standard radiation warning trefoil and the words, "Caution, Radioactive Material"
- an individual designated to maintain control of assigned accountable sources (The individual shall be trained as a radiological worker in accordance with 10 CFR 835.902 and instructed on site-specific source control procedures.)
- periodic inventory of each accountable source at intervals not to exceed 6 months (The inventory should verify (1) physical location of each source, (2) adequacy of postings and labels, and (3) adequacy of storage locations, containers, and devices.)
- integrity testing of each source (with an activity exceeding 0.005 µCi) upon receipt, when damage is suspected, and at intervals not to exceed 6 months

Personnel should also review the following guidance to ensure adequate accountability of radioactive sources.

- DOE/EH-256T, *Radiological Control Manual,* requires control and accountability of sealed radioactive sources. It states that each person involved in radiological work is expected to demonstrate responsibility and accountability through an informed, disciplined, and cautious attitude toward radiation and radioactivity.
- DOE N 441.3, *Radiological Protection for DOE Activities*, requires control and accountability of sealed radioactive sources. However, this notice applies only to defense nuclear facilities. The majority of pertinent radiological protection requirements have become codified through promulgation of 10 CFR 835, *Occupational Radiation Protection*. However, 10 CFR 835 currently does not address sealed radioactive source accountability; source accountability will be addressed in a pending amendment.
- DOE Implementation Guide G-N 5400.9/M1-Rev.1, *Sealed Radioactive Source Accountability and Control*, provides guidance for establishing and operating a sealed source accountability and control program. Specific guidance includes organization and responsibilities, receipt, labeling and storage, inventory, integrity testing, and handling and disposal.

Links to DOE radiation protection documents, including the sealed source position paper, can be found at URL http://tis-nt.eh.doe.gov/wpphm/regs/regs.htm. The NRC maintains a sealed source database. The database can be found at URL http://www.NRC.gov/NRC/FEDWORKD/NRC-SSD/index.html. This database provides a list of sealed sources licensed by the NRC and a variety of information on sealed sources.

KEYWORDS: sealed source, accountability, radiation protection

FUNCTIONAL AREAS: Radiation Protection

4. PUMP CASING RUPTURE CAUSES MINOR INJURIES

On August 5, 1998, at the Oak Ridge Y-12 Chiller Building, a pump casing ruptured catastrophically and projected debris throughout an operating area, causing extensive damage to nearby equipment and structures and injuring an operator. The operator received superficial cuts on the face and upper chest when pump debris struck and shattered a heavy glass window in an enclosed control area. Responders transported the operator to a local medical center, where he was treated and released. The pump is one of six large, single-stage centrifugal pumps powered by 2,300 volts-ac, 450 horsepower motors. This occurrence was a very serious near-miss, as anyone in the unprotected area near the pump could have been seriously or fatally injured. (ORPS Report ORO--LMES-Y12SITE-1998-0039)

The facility manager directed operating personnel to evaluate the status of the facility for safety of continued operation. He also initiated a comprehensive investigation to determine causal factors, long-term corrective actions, and lessons learned. Investigators are reassembling the pump fragments and performing metallurgical tests to determine the direct cause of the failure.

OEAF engineers reviewed the complete ORPS database for reports involving failed pump casings and found ten occurrences. A 100 percent review of these occurrences identified two events that could have resulted in personnel injury.

- On January 19, 1994, at the Sandia National Laboratory, a hydraulic oil pump casing split under pressure from a system charge pump and sprayed approximately 200 gallons of oil under high pressure into an underground centrifuge facility. Investigators determined that the direct and contributing causes were mechanical failure attributable to metal fatigue and cracking. (ORPS Report ALO--KO-SNL-2000-1994-0002)

- On February 3, 1966, a boiler feed pump casing fractured and expelled water near the boiling point into an operating space. Investigators determined that the most likely causes of failure were a combination of aging, hairline cracks, and thermal stress. (ORPS Report RL--WHC-KHS&W-1996-0003)

OEAF engineers will continue to track this occurrence and will provide additional information as it becomes available.

KEYWORDS: pump, injury

FUNCTIONAL AREAS: Operations

5. NUCLEAR MATERIAL STORAGE AREA MASS LIMITS VIOLATED DURING TRAINING PREPARATIONS

On August 11, 1998, at the Los Alamos Pajarito Laboratory, an instructor preparing a demonstration experiment for a criticality safety training course added a mass of special nuclear material to other materials on a cart and exceeded the allowable mass limit for a single storage area. A group leader immediately notified the facility manager of the event. In response to the incident, the division director ordered a stand-down of manual handling of special nuclear

materials at the site. Investigators determined that the instructors performed the demonstration experiments in accordance with procedures for handling special nuclear materials and memorandums that included instructions for conducting them. Analysis and calculations of change to the multiplication factor indicated that there was no significant reduction in the margin of criticality safety. Failure to comply with fissile materials mass limits can significantly reduce criticality safety margins. (ORPS Report ALO--LA-LANL-TA18-1998-0008)

One of the course instructors selected a 4.5-kilogram mass of stainless steel-clad alpha-phase plutonium and a neutron/gamma source to demonstrate nuclear instrument response to various types of special nuclear materials and other radioactive materials. He could not locate a third mass, one he intended to be depleted uranium, so he selected a 9.5-kilogram mass of 10 percent enriched uranium that was readily available. He placed the three items in appropriate containers and placed them in standby positions for use in the demonstration. A second instructor later placed the three containers onto the cart for the demonstration. He assumed the enriched uranium he placed on the cart was depleted uranium. However, as he placed the plutonium mass onto the cart, he realized that the second mass was actually fissile material and removed the plutonium from the cart, contrary to criticality safety event response requirements.

The division director held a critique of this event. Based on discussions of procedures and formality of operations, the division director concluded that there is a pervasive lack of formality of site operations. Attendees learned that facility personnel had not incorporated informal instructions for handling special nuclear material into formal procedures. Attendees also learned that at least one of the instructors was not regularly assigned to the types of demonstrations being performed. The division director ordered a broader stand-down of all site operations except for necessary compliance activities. Division managers are preparing a stand-down and resumption plan that will address formality of operations and ensure continued safe stand-down. Resumption plans will address the root causes of this and other recent occurrences at the site.

OEAF engineers searched the ORPS database for related occurrences at the Los Alamos Critical Experiments Facility. Root causes for the following occurrences were identified as personnel error, procedure problem, or management problem.

- On May 8, 1998, the facility manager learned that a facility technical specification was violated when reactor start-up channel instrument calibrations were not documented. (ORPS Report ALO-LA-LANL-TA18-1998-0003)

- On May 18, 1998, the Los Alamos Critical Experiments Facility installed a lightning protection system without conducting a screening for unreviewed safety questions. The modification could have affected electrical systems associated with critical assembly safety circuitry. (ORPS Report ALO-LA-LANL-TA18-1998-0005)

- On June 10, 1998, researchers at the Los Alamos Critical Experiments Facility failed to make required notifications and activate warning lights before conducting radiography experiments. (ORPS Report ALO--LA-LANL-TA18-1998-0006)

- On July 8, 1998, employees preparing for a critical experiment missed a security guard during a sweep of the radiological controlled area associated with the operation. (ORPS Report ALO-LA-LANL-TA18-1998-0007)

These events illustrate the importance of formality in operations, particularly with respect to providing and using formal procedures for operations with safety implications. Informality in operations relies heavily on the knowledge, experience, and attitudes of facility personnel to carry out operations safely and in accordance with applicable standards. When inexperienced personnel become involved in operations or when unexpected conditions occur, lack of formality can lead to serious infractions with a broad spectrum of consequences.

Facility managers and supervisors should review the following guidance.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter XVI, "Operations Procedures," requires procedures that provide direction to ensure that facilities are operated within their design bases. The Order also requires procedures to be used effectively to support safe operation of facilities.

- DOE-STD-1029-92, *Writers Guide for Technical Procedures*, provides guidance to assist procedure writers across the DOE complex in producing accurate, complete, and usable procedures that promote safe and efficient operation. Attention should be given to writing, reviewing, and monitoring procedures to ensure that content is technically correct and wording and format are clear.

KEYWORDS: criticality safety violation, conduct of operations, configuration control, procedure

FUNCTIONAL AREAS: Conduct of Operations, Procedures, Training and Qualification

OEAF FOLLOW-UP ACTIVITY

1. PRELIMINARY ACCIDENT INVESTIGATION FINDINGS FROM IDAHO ACCIDENT

On July 28, 1998, at the Idaho National Engineering and Environmental Laboratory Test Reactor Area, one electrician died and several others were seriously injured when fire retardant (carbon dioxide) was accidentally discharged during scheduled electrical maintenance operations. Workers electronically impaired the high-pressure, carbon-dioxide fire protection system and shut down the electrical power system as part of work preparations for preventive maintenance. The carbon-dioxide system activated coincident with the de-energization of the last 4,160-kV circuit breaker. (DOE/EH-0196, *Preliminary Accident Investigation Findings from Idaho Accident*, OE Weekly Summary 98-30, ORPS Report ID--LITC-TRA-1998-0010)

A DOE Type A Accident Investigation Board will issue a final report, which will identify the judgements of need to help prevent recurrence throughout the department, within several weeks. Until this report is available, the Investigation Board recommends that personnel at facilities with high-pressure, carbon-dioxide fire suppression systems consider the applicability of the following.

- using physical isolation (valve-out and danger tag) versus electronic impairment (defeat initiation signal at fire alarm panel)

- recognizing the potential for initiation of the carbon-dioxide fire suppression system from a spurious signal and failure to receive a 30-second evacuation alarm before activation

- pre-staging self-contained breathing apparatus near or in facilities with carbon-dioxide systems to facilitate escape or search and rescue

- training employees on the personnel hazard of carbon-dioxide fire suppression systems, evacuation alarms, and emergency response, including the conduct of evacuation drills

- analyzing the carbon-dioxide hazard and ensuring the capability to safely escape on system activation or to accomplish search and rescue following a carbon dioxide system activation, including consideration of:

    1. escape pathway obstacles (breakers, panels, lights, equipment carts, ladders, etc.)

    2. locked entrance doors that would impede search and rescue

    3. effects of carbon-dioxide “whiteout” conditions with zero visibility

    4. normal, emergency, and exit path lighting

    5. personnel protective equipment

    6. personnel accountability mechanisms to determine if victims remain in the building

OEAF engineers reviewed the operating experience of commercial nuclear facilities for events involving the accidental discharge of carbon-dioxide fire suppression systems since 1980 and found 14 events. Six of these discharges occurred during some phase of system maintenance or surveillance. Three resulted from moisture intrusion; two more from detector faults; two were attributed to spurious activation; and one resulted from a relay fault.

KEYWORDS: carbon dioxide, electrical maintenance, fatality, fire retardant

FUNCTIONAL AREAS: Electrical Maintenance, Fire Protection, Industrial Safety

FINAL REPORT

This section of the OE Weekly Summary discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. CONTRACTOR CUTS ELECTRICAL CABLE AT SANDIA

This week OEAF engineers reviewed a final occurrence report about a September 23, 1997, incident at Sandia National Laboratory, where a concrete-coring contractor drilled into an energized 480-volt line while installing a chilled water line. The contractor was wearing personnel protective equipment and was not injured. Investigators determined that the work permit specified running the line across a wall, then drilling through a floor into the basement, but a contractor superintendent decided to change the routing of the line. As a result of this incident, and an earlier incident involving an operator who cut a 120-volt energized line while cutting a floor slab, Sandia Laboratory managers directed a stand-down of all coring and saw-cutting activities. (ORPS Report ALO-KO-SNL-NMFAC-1997-0015)

Investigators determined that the work permit and hazard penetration assessment specified that the chilled water line was to run exposed on the wall and pass through the floor into the basement. They also determined that the contractor superintendent believed that this route would interfere with existing utilities and disrupt Laboratory operations, so he decided to re-route the line through an upper basement wall instead of through the floor. Investigators determined that a hazard review, including a review of work-site drawings, did not show there was conduit in the basement wall. They also determined that no one attempted to detect the presence of conduit in the work area with utility detection equipment and that the penetration permit did not address the changed coring location.

Direct and Root Causes

The facility manager identified defective or inadequate procedures as both the root and direct cause of the incident because (1) the hidden hazards penetration permit process did not adequately support changing job conditions; (2) the hazard analysis did not include use of utility detection methods to ensure that core-drilling in the new location would not result in cut electrical circuits; and (3) there was no clear responsibility for ensuring that detection services were provided.

Contributing Causes

Investigators identified lack of adequate training for inspectors, design staff, and contractors on the responsibilities and implementation of the hidden hazards permit process as contributing factors to this event. The facility manager also reported several contributing factors, including the following.

- Neither the drawing review nor the site review indicated the presence of conduit in the work site.
- The digging permit did not indicate the area of the penetration.
- No one was responsible for ensuring that a new digging permit was issued when the work location was changed.

The facility manager directed appropriate personnel to implement the following corrective actions.

- Review the hidden hazard permit process and modify it as necessary to ensure that additional detection services are required after any changes to the design.
- Provide contractor training on the hidden hazard penetration permit process.
- Inform all site contractors of requirements for core drilling.
- Require inspectors to ensure that a detection step is included in work plans.
- Require personnel to wear appropriate personal protective equipment, including insulated protective gloves, when performing work in areas where there may be electrical hazards.

This event underscores the importance of ensuring work packages are adequately reviewed and reflect any changes in job scope or conditions. Discrepancies between planned conditions and as-found conditions can result in confusion and increase the potential for errors in work package execution. Walk-downs are an effective means for ensuring that planned conditions reflect

conditions in the field. This event also underscores the importance of following work package steps. If conditions found are not as outlined in the work package, work should be stopped immediately and, if necessary, changes should be made to the work package using approved change control methods.

Construction project managers and work control managers should review the following guidance to ensure that work packages are effectively written and that appropriate work controls procedures are in place.

- DOE O 440.1A, *Worker Protection for DOE Federal and Contractor Employees*, states that construction project managers shall ensure that project safety and health plans are approved before any on-site project work and that required hazard analyses must be completed and approved before work begins on affected construction operations.

- DOE O 4330.4B, *Maintenance Management Program*, section 8.3.1, provides guidelines on work control systems and procedures. It states that work control procedures help personnel understand the requirements and controls required for work.

- DOE-STD-1050-93, *Guidelines to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities,* provides information on work controls and work coordination.

KEYWORDS: training, modifications, procedures, drilling

FUNCTIONAL AREAS: Modifications, Work Planning, Industrial Safety